

CLAIMS

Claim 1 A magnetic recording medium having at least a magnetically anisotropic recording film on a disk substrate,

5 comprising a lubricating layer over at least the recording film, with a protective layer having a lower thermal conductivity than the recording film being interposed therebetween.

Claim 2 The magnetic recording medium according to Claim 1, wherein the protective layer has a thermal conductivity of 1×10^6 erg/(s·K·cm) or less.

10 Claim 3 The magnetic recording medium according to Claim 1, wherein the protective layer comprises a plurality of thin films.

15 Claim 4 The magnetic recording medium according to Claim 3, wherein the plurality of thin films each have a different thermal conductivity.

20 Claim 5 The magnetic recording medium according to Claim 4, wherein the protective layer comprising a plurality of thin films is formed such that the thermal conductivity of the thin film on the recording film side is higher than the thermal conductivity of the thin film on the lubricating layer side.

Claim 6 The magnetic recording medium according to Claim 4 or 5, wherein the protective layer comprising a plurality of thin films has at least a thin film whose thermal conductivity is 1×10^6 erg/(s·K·cm) or less.

25 Claim 7 The magnetic recording medium according to Claims 1 to 6, wherein the main component of the protective layer is carbon.

30 Claim 8 The magnetic recording medium according to Claim 7, wherein the protective layer includes diamond-like carbon.

Claim 9 The magnetic recording medium according to Claim 8, wherein the

protective layer includes nitrogen, oxygen, or hydrogen.

Claim 10 The magnetic recording medium according to Claim 9, wherein the nitrogen, oxygen, or hydrogen content is varied within the plurality of thin films of the protective layer.

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Claim 11 The magnetic recording medium according to Claims 1 to 6, wherein the protective layer includes a material having heat resistance at a temperature of at least 250°C.

Claim 12 The magnetic recording medium according to Claim 11, wherein the heat
10 resistant material is composed of a fluororesin or a ceramic material.

Claim 13 The magnetic recording medium according to Claim 11, wherein the heat
resistant material is composed of Teflon®.

15 Claim 14 The magnetic recording medium according to Claims 1 to 6, wherein the protective layer includes a metal material.

Claim 15 The magnetic recording medium according to Claim 14, wherein the metal
material is composed of titanium, tantalum, and chromium.

20 Claim 16 The magnetic recording medium according to Claim 14, wherein the metal
material is composed of a nitrogen compound or an oxide.

Claim 17 The magnetic recording medium according to Claims 1 to 6, wherein the
25 protective layer includes at least a chalcogen compound.

Claim 18 The magnetic recording medium according to Claim 1, wherein the
lubricating layer comprises a plurality of thin films.

30 Claim 19 The magnetic recording medium according to Claim 18, wherein the
plurality of thin films each have a different thermal conductivity.

Claim 20 The magnetic recording medium according to Claim 18 or 19, wherein the lubricating layer includes PFPE.

Claim 21 The magnetic recording medium according to Claim 18 or 19, wherein the lubricating layer includes a heat resistant material.

Claim 22 The magnetic recording medium according to Claim 18 or 19, wherein the lubricating layer includes an oxide or a nitride.

Claim 23 The magnetic recording medium according to Claims 1 to 22, wherein the combined thickness of the lubricating layer and the protective layer is at least 1 nm and no more than 100 nm.

Claim 24 The magnetic recording medium according to Claim 23, wherein the thickness of the lubricating layer is at least 0.5 nm and no more than 20 nm.

Claim 25 The magnetic recording medium according to Claim 23 or 24, wherein the thickness of the protective layer is at least 0.5 nm and no more than 99.5 nm.

Claim 26 The magnetic recording medium according to Claim 1, wherein the recording film includes a magnetic layer having magnetic anisotropy in the direction perpendicular to the film plane.

Claim 27 The magnetic recording medium according to Claim 1, wherein the recording film comprises a plurality of magnetic layers.

Claim 28 The magnetic recording medium according to Claim 27, wherein the recording film comprises at least a recording layer, an intermediate layer, and a reproduction layer, which are laminated over one another.

Claim 29 The magnetic recording medium according to Claim 28, wherein the recording domain formed on the recording layer in the recording film is transferred to the

reproduction layer, and recorded information is reproduced by domain wall displacement in the reproduction layer.

5 Claim 30 The magnetic recording medium according to Claim 28 or 29, wherein the recording layer includes at least terbium, iron, and cobalt.

10 Claim 31 The magnetic recording medium according to Claim 28 or 29, wherein the recording layer is laminated intermittently and periodically for each layer of different material or compositional ratio.

15 Claim 32 The magnetic recording medium according to Claim 1, wherein a pit-shaped pattern is formed on the disk substrate according to the pattern of the recording domain formed in the recording layer.

20 Claim 33 The magnetic recording medium according to Claim 32, wherein a pit-shaped pattern that is smaller than the smallest pattern of the recording domain formed in the recording layer is formed on the disk substrate.

25 Claim 34 The magnetic recording medium according to Claim 32 or 33, wherein at least a metal layer with a high thermal conductivity is provided between the disk substrate and the recording film.

30 Claim 35 The magnetic recording medium according to Claim 34, wherein a dielectric layer is provided between the recording film and the metal layer.

35 Claim 36 The magnetic recording medium according to Claim 34, wherein a dielectric layer is provided between the disk substrate and the metal layer.

40 Claim 37 The magnetic recording medium according to Claims 34 to 36, wherein at least the metal layer or the dielectric layer has an etched surface.

45 Claim 38 The magnetic recording medium according to Claim 37, wherein at least the

metal layer or the dielectric layer has a surface roughness Ra of at least 0.5.

Claim 39 The magnetic recording medium according to Claims 35 to 38, wherein the dielectric layer includes at least a chalcogen compound.

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Claim 40 A method for manufacturing a magnetic recording medium having at least a magnetically anisotropic recording film on a disk substrate, comprising:

forming at least a magnetically anisotropic recording film on a disk substrate;

10 forming a protective layer having a lower thermal conductivity than the recording film over the recording film; and

forming a lubricating layer over the protective layer.

Claim 41 The method for manufacturing a magnetic recording medium comprising according to Claim 40, wherein the lubricating layer is formed in a vacuum.

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Claim 42 The method for manufacturing a magnetic recording medium comprising according to Claim 41, wherein the lubricating layer is formed by coating after the protective layer has been formed.

20 Claim 43 An apparatus for manufacturing a magnetic recording medium having at least a magnetically anisotropic recording film on a disk substrate, the apparatus comprising:

a recording film formation unit for forming at least a magnetically anisotropic recording film on a disk substrate;

25 a protective layer formation unit for forming a protective layer having a lower thermal conductivity than the recording film over the recording film; and

a lubricating layer formation unit for forming a lubricating layer over the protective layer.

Claim 44 A method for recording to or reproducing from a magnetic recording medium having at least a magnetically anisotropic recording film on a disk substrate,

30 wherein information is recorded to or reproduced from the magnetic recording medium by applying a laser beam to the information recording medium according to Claims 1 to 39 to raise the temperature of the recording film of the recording medium.

Claim 45 An apparatus for recording to or reproducing from a magnetic recording medium having at least a magnetically anisotropic recording film on a disk substrate, comprising:
a heating unit for raising the temperature of the magnetic recording medium according to

5 Claims 1 to 39; and

a recording and reproduction unit for magnetically recording and reproducing signals to and from the magnetic recording medium when the heating unit raises the temperature of the magnetic recording medium,

10 wherein the temperature distribution in the signal region of the magnetic recording medium during signal recording to the magnetic recording medium is different from that during signal reproduction.